

CLAIMS

I/We claim:

- [c1] 1. An apparatus for launching an unmanned aircraft, comprising:
a first launch member;
a second launch member positioned at least proximate to the first launch member, at least one of the first and second launch members being movable relative to the other between a first position and a second position; and
a launch carriage having an aircraft support positioned to releasably carry an unmanned aircraft during a takeoff operation, the launch carriage being in contact with the first and second launch members, the launch carriage being movable relative to the launch members between a first launch carriage location and a second launch carriage location as the at least one of the first and second launch members moves from the first position to the second position.
- [c2] 2. The apparatus of claim 1 wherein the launch carriage moves in a first direction between the first launch carriage location and the second launch carriage location, and wherein the at least one launch member moves in a second direction transverse to the first direction between the first position and the second position.
- [c3] 3. The apparatus of claim 1, further comprising a support structure, and wherein the first and launch members are carried by the support structure.
- [c4] 4. The apparatus of claim 1, further comprising an actuator coupled to the at least one launch member to move the at least one launch member relative to the other.

[c5] 5. The apparatus of claim 1, further comprising an actuator coupled to the at least one launch member to move the at least one launch member relative to the other, and wherein the actuator includes at least one of a hydraulic cylinder, a spring, a pneumatic cylinder, an electric motor, a flywheel, a steam-powered apparatus, an explosive charge, and a weight.

[c6] 6. The apparatus of claim 1, further comprising an energy reservoir coupled to the at least one launch member to move the at least one launch member.

[c7] 7. The apparatus of claim 1, further comprising:
an actuator; and
a transmission coupled between the actuator and the second launch member, wherein the transmission includes a first portion coupled to the actuator to receive a first force from the actuator and accelerate with a first acceleration, the transmission further including a second portion coupled to second launch member to impart a second force and a second acceleration to the launch carriage, wherein the second force is different than the first force and the second acceleration is different than the first acceleration.

[c8] 8. The apparatus of claim 1 wherein at least one of the first and second launch members includes a braking portion, and wherein the braking portion is positioned to contact and decelerate the launch carriage as the launch carriage moves from the first launch carriage location to the second launch carriage location.

[c9] 9. The apparatus of claim 1 wherein at least one of the first and second launch members includes a curved portion, and wherein the curved portion is shaped to provide constant acceleration to the launch carriage as the at least one of the first and second launch members moves relative to the other.

- [c10] 10. The apparatus of claim 1 wherein:
the first launch member includes a first roller surface and the second launch member includes a second roller surface non-parallel to the first roller surface; and
the launch carriage includes a first wheel in rolling contact with the first roller surface and a second wheel in rolling contact with the second roller surface.
- [c11] 11. The apparatus of claim 1 wherein the first launch member includes a first surface in contact with the launch carriage, and wherein the second launch member includes a second surface in contact with the launch carriage, the second surface having a first portion oriented at a first angle relative to the first surface to accelerate the launch carriage, the second surface having a second portion oriented at a second angle relative to the first surface to decelerate the launch carriage, the second angle being different than the first angle.
- [c12] 12. The apparatus of claim 1 wherein the second launch member translates and pivots relative to the first launch member from the first position to the second position.
- [c13] 13. The apparatus of claim 1 wherein the second launch member includes a guide pin, and wherein the apparatus further comprises a guide having an elongated guide slot positioned between the first and second launch members, the guide pin being received in the guide slot to allow the guide pin to translate along the guide slot while the second launch member rotates relative to the first launch member.
- [c14] 14. The apparatus of claim 1, further comprising a carriage return coupled to the launch carriage, the carriage return being positioned to reset the launch carriage to the first launch carriage location after takeoff of the aircraft.

- [c15] 15. The apparatus of claim 1 wherein the at least one launch member moves in a generally vertical plane between the first position and the second position.
- [c16] 16. The apparatus of claim 1 wherein the at least one launch member moves in a generally horizontal plane between the first position and the second position.
- [c17] 17. The apparatus of claim 1 wherein the first and second launch members are coupled to each other with a cable and an arrangement of pulleys.
- [c18] 18. The apparatus of claim 1 wherein the first and second launch members are coupled to each other with a four-bar linkage.
- [c19] 19. The apparatus of claim 1 wherein the first and second launch members are pivotable relative to each other.
- [c20] 20. The apparatus of claim 1 wherein the first launch member includes a first roller surface and the second launch member includes a second roller surface non-parallel to the first roller surface, and wherein the angle between the first and second roller surfaces is greater when the launch carriage is in the second launch carriage location than when the launch carriage is in the first launch carriage location.
- [c21] 21. The apparatus of claim 1, further comprising the unmanned aircraft.
- [c22] 22. An apparatus for launching an unmanned aircraft, comprising:
a support structure;
a first launch member fixed relative to the support structure;

a second launch member coupled to the support structure, the second launch member being movable relative to the support structure and the first launch member;

an actuator coupled to the second launch member and positioned to move the second launch member relative to the first launch member from a first position to a second position; and

a launch carriage having an aircraft support positioned to releasably carry an unmanned aircraft during a takeoff operation, the launch carriage being in contact with the first and second launch members, the launch carriage being movable relative to the first and second launch members between a first launch carriage location and a second launch carriage location as the second launch member moves from the first position to the second position.

[c23] 23. The apparatus of claim 22 wherein the actuator includes at least one of a hydraulic cylinder, a spring, a pneumatic cylinder, an electric motor, a flywheel, a steam-powered apparatus, an explosive charge, and a weight.

[c24] 24. The apparatus of claim 22, further comprising a transmission coupled between the actuator and the second launch member, wherein the transmission includes a first portion coupled to the actuator to receive a first force from the actuator and accelerate with a first acceleration, the transmission further including a second portion coupled to second launch member to impart a second force and a second acceleration to the launch carriage, wherein the second force is different than the first force and the second acceleration is different than the first acceleration.

[c25] 25. The apparatus of claim 22 wherein the first launch member includes a first surface in contact with the launch carriage, and wherein the second launch member includes a second surface in contact with the launch carriage, the second surface having a first portion oriented at a first angle relative to the first surface to

accelerate the launch carriage, the second surface having a second portion oriented at a second angle relative to the first surface to decelerate the launch carriage, the second angle being different than the first angle.

[c26] 26. The apparatus of claim 22 wherein:
the first launch member includes a first roller surface and the second launch member includes a second roller surface non-parallel to the first roller surface; and
the launch carriage includes a first wheel in rolling contact with the first roller surface and a second wheel in rolling contact with the second roller surface.

[c27] 27. The apparatus of claim 22 wherein the second launch member translates and pivots relative to the first launch member as the second launch member moves from the first position to the second position.

[c28] 28. The apparatus of claim 22, further comprising a carriage return coupled to the launch carriage, the carriage return being positioned to reset the launch carriage to the first launch carriage location after takeoff of the aircraft.

[c29] 29. An apparatus for launching an unmanned aircraft, comprising:
a first launch member;
a second launch member pivotally coupled to the first launch member, at least one of the first and second launch members being pivotable relative to the other between a first position and a second position;
an actuator coupled to the at least one launch member and positioned to pivot the at least one launch member from the first position to the second position; and
a launch carriage having an aircraft support positioned to releasably carry an unmanned aircraft during a takeoff operation, the launch carriage being in contact with the first and second launch members, the

launch carriage being forced to move relative to the launch members between a first launch carriage location and a second launch carriage location as the at least one launch member moves from the first position to the second position.

[c30] 30. The apparatus of claim 29 wherein the first launch member includes a first surface in contact with the launch carriage, and wherein the second launch member includes a second surface in contact with the launch carriage, the second surface having a first portion oriented at a first angle relative to the first surface to accelerate the launch carriage, the second surface having a second portion oriented at a second angle relative to the first surface to decelerate the launch carriage, the second angle being different than the first angle.

[c31] 31. The apparatus of claim 29 wherein:
the first launch member includes a first roller surface and the second launch member includes a second roller surface non-parallel to the first roller surface; and
the launch carriage includes a first wheel in rolling contact with the first roller surface and a second wheel in rolling contact with the second roller surface.

[c32] 32. The apparatus of claim 29 wherein the at least one launch member moves in a generally lateral plane.

[c33] 33. The apparatus of claim 29 wherein each of the first and second launch members pivots relative to the other.

[c34] 34. The apparatus of claim 29 wherein the actuator includes at least one of a hydraulic cylinder, a spring, a pneumatic cylinder, an electric motor, a flywheel, a steam-powered apparatus, an explosive charge, and a weight.

[c35]

35. The apparatus of claim 29 wherein:
the first and second launch members each include a first end portion and a second end portion spaced apart from the first end portion;
the first end portions of the first and the second launch member are pivotally coupled together; and
the second end portions of the first and the second launch members are coupled to the actuator, and wherein the actuator is positioned to move the second end portions of the first and the second launch member apart from each other.

[c36]

36. The apparatus of claim 29, further comprising a carriage return coupled to the launch carriage, the carriage return being positioned to reset the launch carriage to the first launch carriage location after takeoff of the aircraft.

[c37]

37. An apparatus for launching an unmanned aircraft, comprising:
carriage means for supporting an unmanned aircraft during a takeoff operation; and
support means for moving the carriage means, the support means including:
first launch means for accelerating the carriage means; and
second launch means for accelerating the carriage means, the first and second launch means being coupled to the carriage means, at least one of the first and second launch means being movable relative to the other to accelerate the carriage means.

[c38]

38. The apparatus of claim 37, further comprising actuating means coupled to the support means to move at least one of the first and second launch means relative to the other.

[c39] 39. The apparatus of claim 37, further comprising braking means carried by the support means to decelerate the carriage means.

[c40] 40. A method for launching an unmanned aircraft, comprising:
releasably supporting an unmanned aircraft with a launch carriage, the launch carriage being movably carried by and in contact with a first launch member and a second launch member;
accelerating the launch carriage from a first launch carriage location to a second launch carriage location by moving at least one of the first and second launch members relative to the other from a first position to a second position while the launch members contact the launch carriage; and
releasing the unmanned aircraft from the launch carriage for flight.

[c41] 41. The method of claim 40, further comprising decelerating the launch carriage to release the aircraft from the launch carriage for flight.

[c42] 42. The method of claim 40 wherein moving at least one of the first and second launch members includes moving the at least one launch member in a generally vertical plane.

[c43] 43. The method of claim 40 wherein moving at least one of the first and second launch members includes moving the at least one launch member in a generally horizontal plane.

[c44] 44. The method of claim 40 wherein moving the at least one of the first and second launch members includes pivoting the second launch member relative to the first launch member.

[c45] 45. The method of claim 40 wherein moving the at least one of the first and second launch members includes translating and pivoting the second launch member relative to the first launch member.

[c46] 46. The method of claim 40, further comprising returning the launch carriage to the first launch carriage location after releasing the aircraft for takeoff.

[c47] 47. A method for launching an unmanned aircraft, comprising:
releasably supporting an unmanned aircraft with a launch carriage, the launch carriage movably carried by and in contact with a first launch member and a second launch member;
activating an actuator coupled to at least one of the first and second launch members;
moving at least one of the first and second launch members relative to the other between a first position and a second position;
accelerating the launch carriage by rolling the launch carriage along the first and second launch members from a first launch carriage location to a second launch carriage location under a force imparted to the launch carriage by the at least one launch member as the at least one launch member moves relative to the other;
decelerating the launch carriage; and
releasing the unmanned aircraft from launch carriage for flight.

[c48] 48. The method of claim 47 wherein moving the at least one launch member includes moving the at least one launch member in a first direction and wherein accelerating the launch carriage includes accelerating the launch carriage in a second direction transverse to the first direction.

[c49] 49. The method of claim 47 wherein moving the at least one of the first and second launch members includes translating and pivoting the second launch member relative to the first launch member.

[c50] 50. The method of claim 47 wherein moving the at least one of the first and second launch members includes pivoting the second launch member relative to the first launch member.

[c51] 51. The method of claim 47, further comprising returning the launch carriage to the first launch carriage location after releasing the aircraft for takeoff.